

“네트워크를 위한 AI Application 발전 방향과 오픈소스”

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TOP AI TRENDS OF 2022

❖ Top AI Trends of 2022

- **Critical Enabler**
 - 6G
 - LCAP (Low-Code Application Platform)
 - Hyperscale Edge Computing
- **The Smart World**
 - Smart Spaces
 - IoT Platform
 - Digital Twin
- **Ubiquitous and Transparent Security**
- **Productivity Revolution**
 - Edge AI
 - Self-Supervised Learning

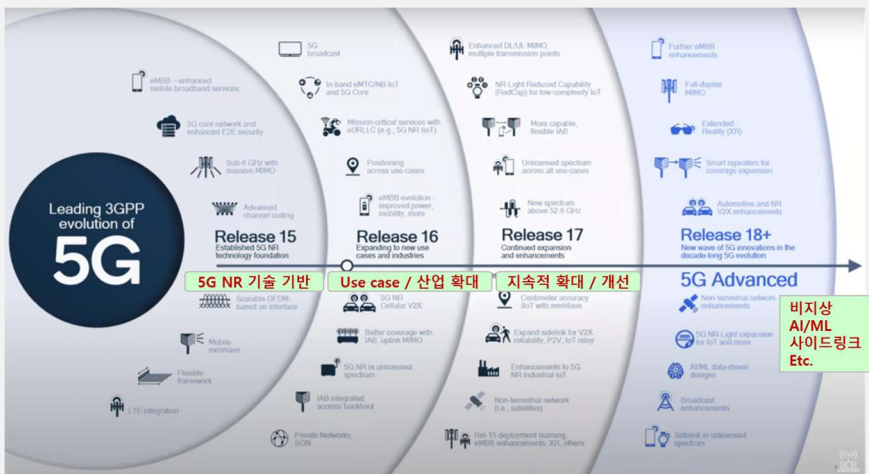


Source: <https://aisupremacy.substack.com/p/top-ai-trends-of-2022>



3GPP RELEASE 18

❖ Key 5G Advanced Features under Study in 3GPP Release 18



5G Advanced
Release 18
(2022 - 2023 Dec expected)

5G System and Packet Core:

- Enhanced support for V2X
- High Altitude Platform System (HAPS)
- Dual Active Protocol Stack (DAPS) improvements
- Network slicing enhancements
- Private 5G/Non-Public Network (NPN) enhancements aimed at non-3GPP deployments
- Service Functionality Chaining (SFC) in 5G System
- 5G-enabled fused location service (LCS) capability
- Enhanced 5G Timing Resiliency
- Inclusion of MEC in roaming

RAN:

- Enhancements for eXtended Reality (XR)
- Sidelink Enhancements aimed at unlicensed, power saving enhancements, efficiency enhancements, and so on
- Evolution of Downlink MIMO with enhanced handling of multiple Transmission Reception Points (multi-TRP) and multibeam
- Evolution of Non-Terrestrial Network aimed at 5G NR and IoT
- Inclusion of traffic characteristics and KPIs for AI/ML
- Evolution of V2X with sidelink enhancements
- Enhancements for Unmanned Aerial Vehicle (UAV)
- Enhanced inter-gNB coordination
- Minimization of Drive Test (MDT) and Self Organizing Networks (SON)
- High Altitude Platform System (HAPS)
- UE Power Savings
- Extended support for frequency bands beyond 52.6GHz
- Carrier Aggregation (CA)/Dual Connectivity (DC) enhancements
- Flexible spectrum integration
- Multicast Broadcast Service (MBS)

• AI/ML KPI

• Multicast Broadcast Service(MBS)

Industry verticals:

- V2X
- Non Terrestrial Networks
- Railway
- Non-3GPP and unlicensed spectrum

• 비지상 네트워크
• 철도
• Non-3GPP 비면허 대역 무선

SBA: Service-Based Architecture
HAPS: High Altitude Platform System
RAN: Radio Access Network
MEC: Multi-Access Edge Compute
NSA: Non-Standalone
SA: Standalone
V2X: Vehicle to Everything

WLAN: Wireless Local Area Network
NR: New Radio
SFC: Service Functionality Chaining
NTN: Non-Terrestrial Networks
LCS: Location Services
NPN: Non-Public Networks
LAN: Local Area Networks
MIMO: Multiple Input Multiple Output

Source: <https://www.3gpp.org/specifications-technologies/3gpp-work-plan>

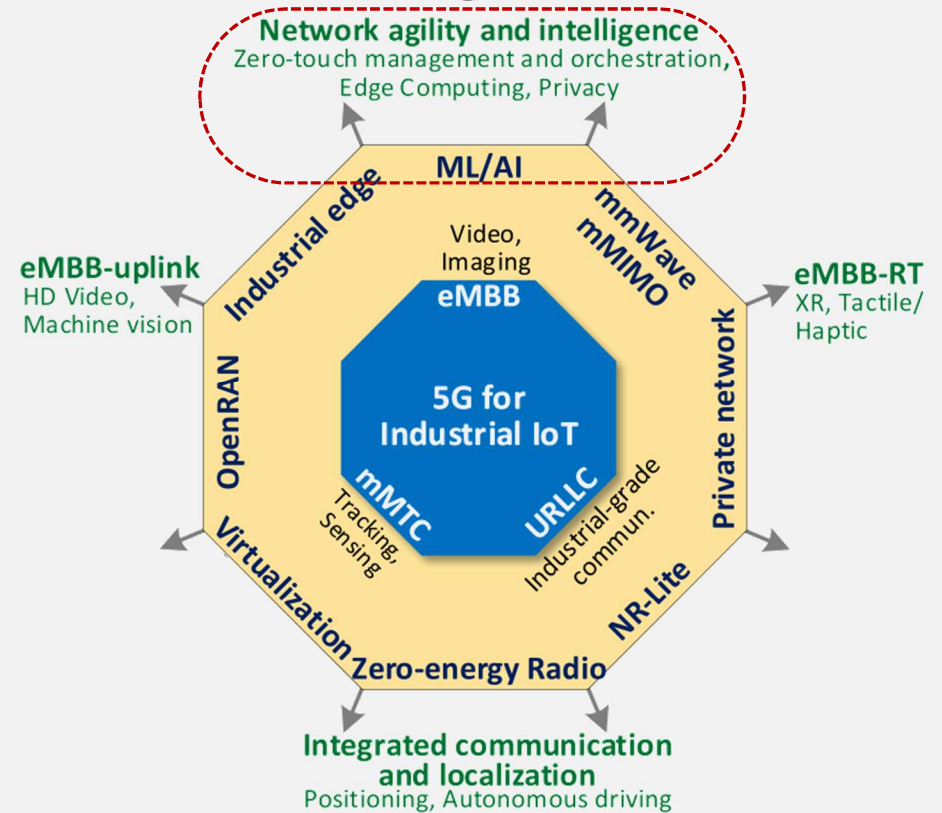
Source: Nair, Pramod (2021-12-06T22:58:59.000). Securing 5G and Evolving Architectures . Pearson Education. Kindle Edition.



5G 발전 방향과 IIoT

❖ 5G 발전 방향과 IIoT(예): Beyond-5G vision, 5G architecture, and design trends for IIoT

- Industrial Edge
- ML/AI
- mmWave/mMIMO
- Private network
- NR-Lite
- Zero-energy Radio
- Virtualization
- OpenRAN

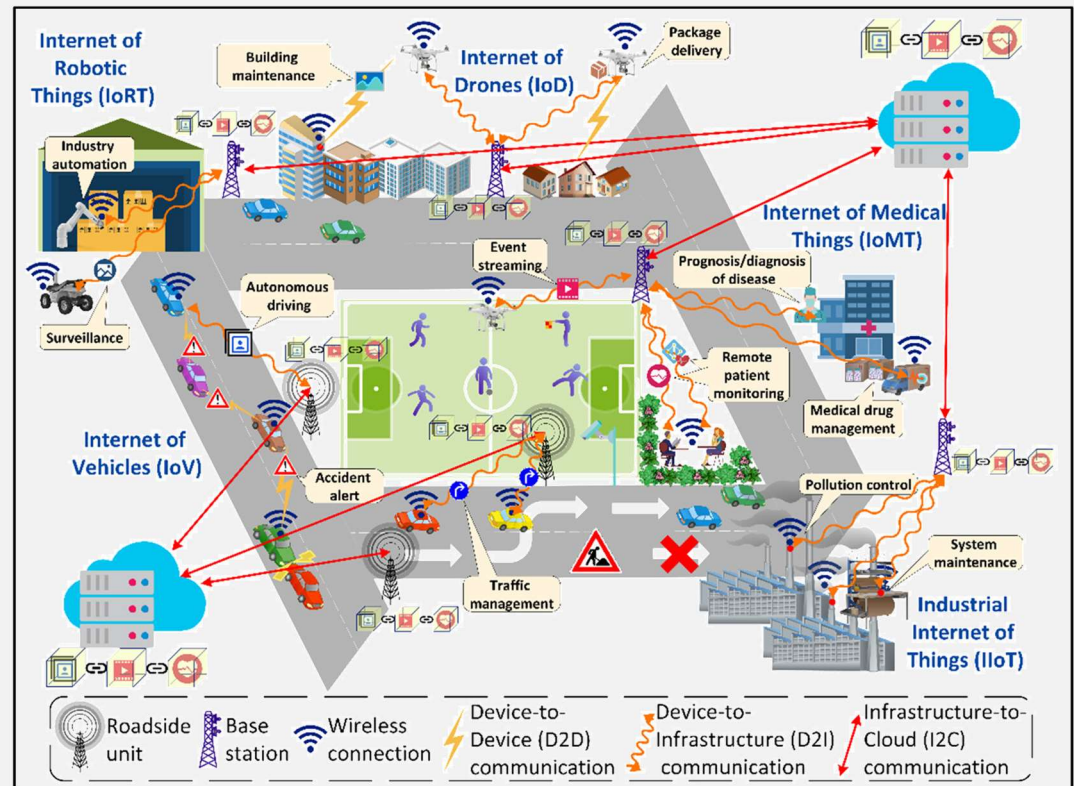


Source: https://www.researchgate.net/figure/Beyond-5G-vision-5G-architecture-and-design-trends-for-IIoT_fig2_354884463



모바일 환경을 위한 EDGE COMPUTING

❖ Artificial Intelligence Applications and Self-Learning 6G Networks (for Smart City)

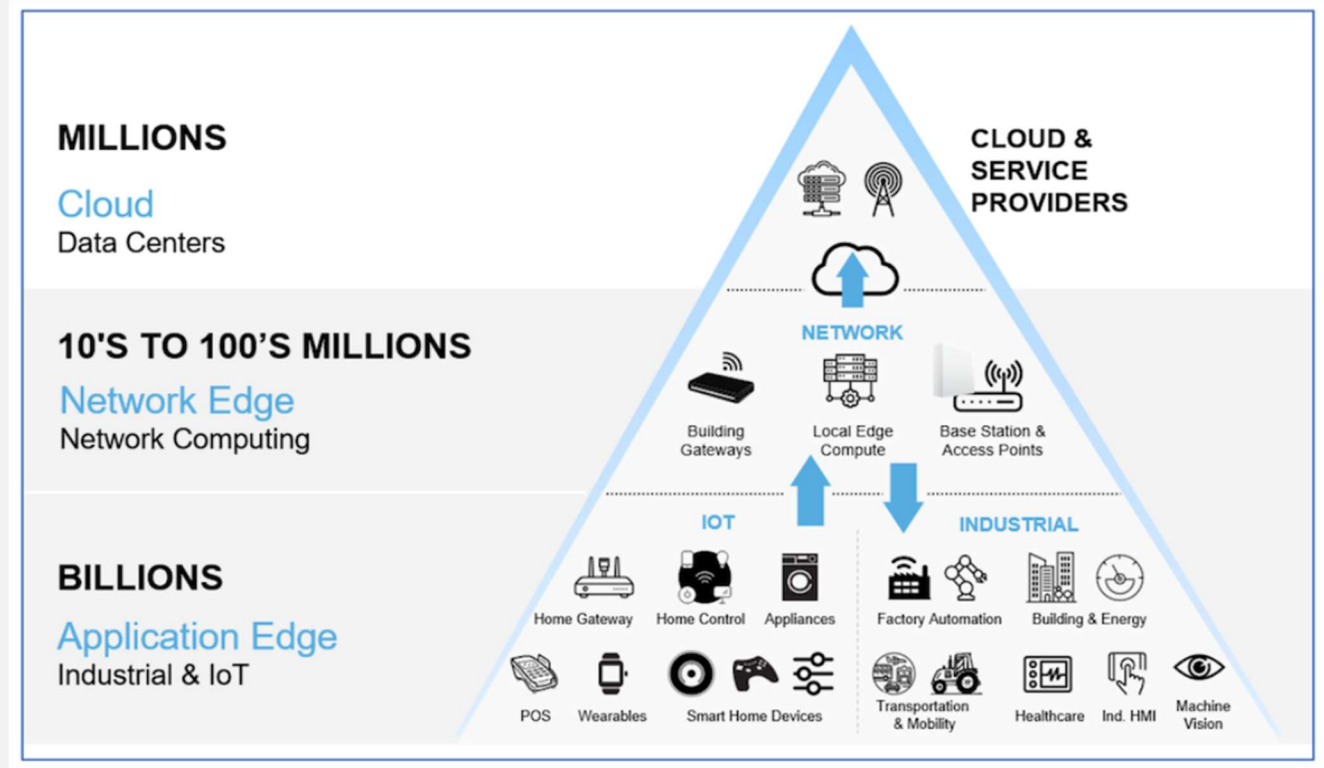


Source: https://www.mdpi.com/1424-8220/22/15/5750/htm?fbclid=IwAR1XXKTpLl2LF4_NG174K3cCzydONGsbU79OmcW1a37-WfaVfd6yU8SdPY8



에지의 AI 와 ML

❖ AI and ML at the edge



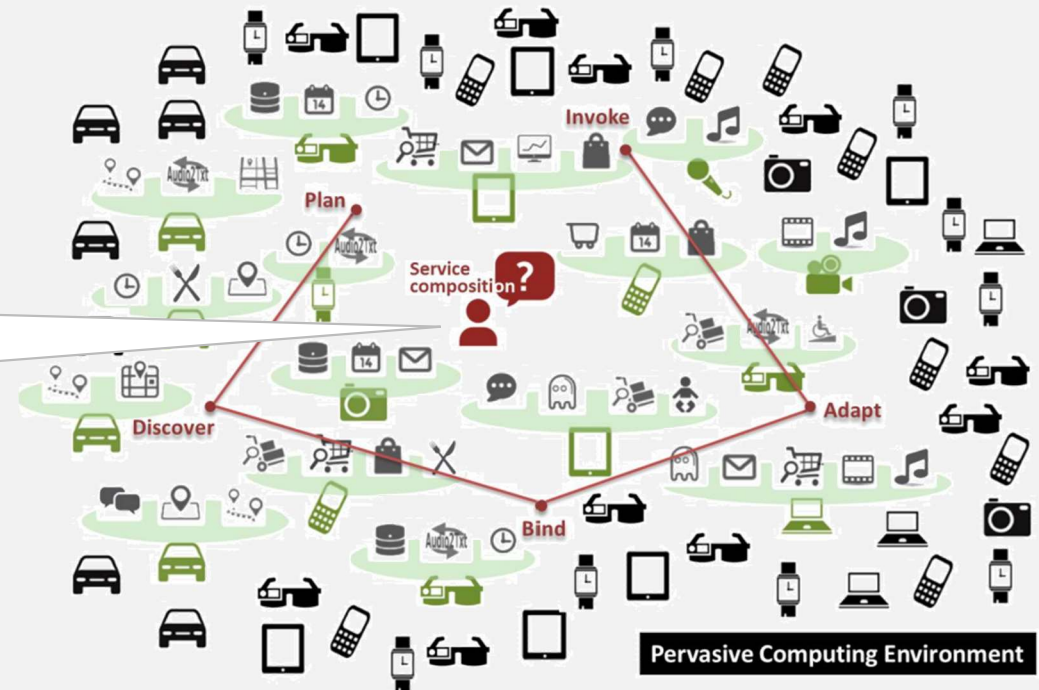
Source: <https://www.voltactivedata.com/blog/2022/01/top-five-telco-trends-and-predictions-for-2022/>



모바일 네트워크를 위한 서비스

- ❖ 모바일 네트워크를 위한 서비스 (예): Motivating scenario 'a smart public space system'.
 - A user issues a complex service request to a pervasive computing environment. Connected entities offer their hardware/software capabilities and local data as microservices.

사용자는 복잡한 서비스 요구를 퍼베이시브 컴퓨팅 환경에 요청하며, 커넥티드 개체들은 하드웨어/소프트웨어 능력과 데이터를 마이크로서비스로서 제공



Pervasive (퍼지는, 널리 미치는, 스며드는)

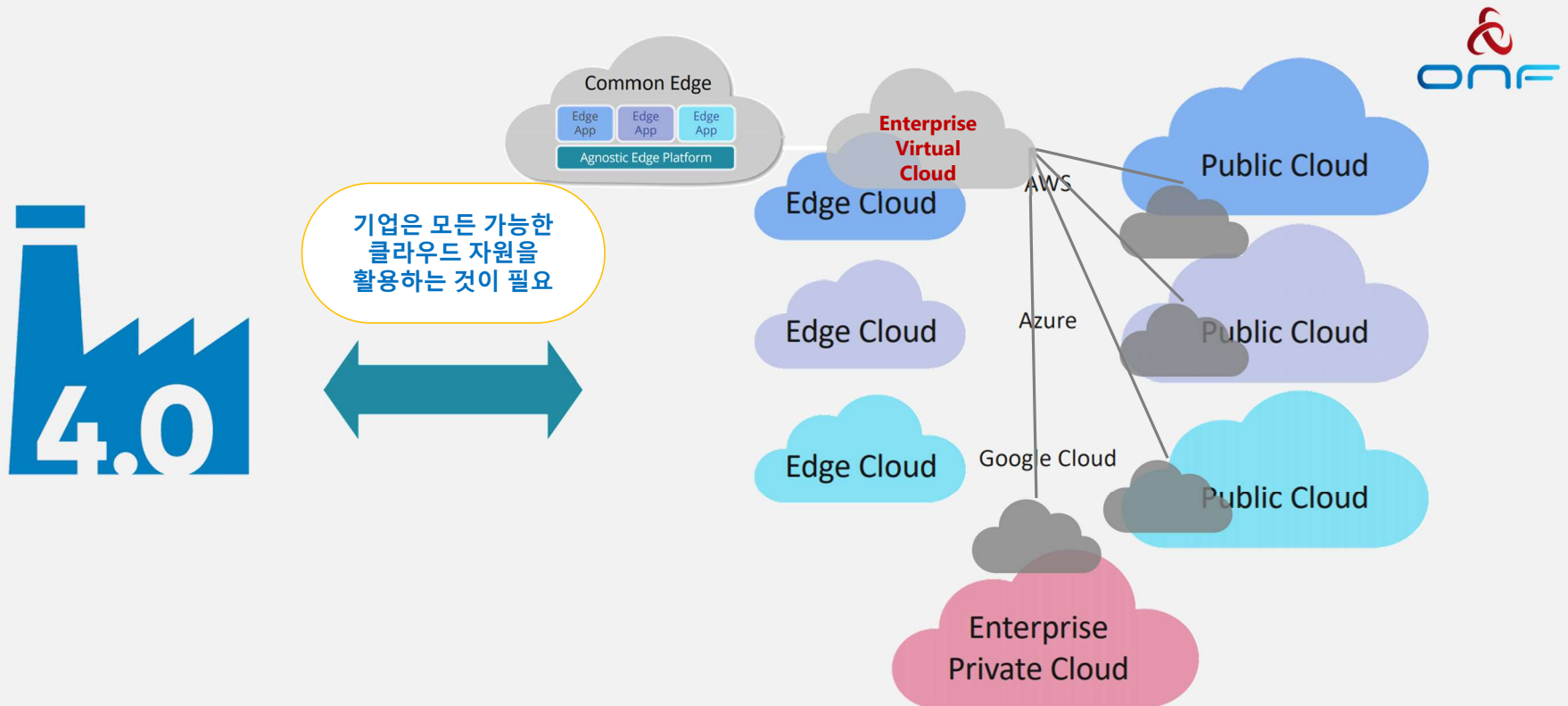
Source: Chen, Nanxi. Mobile Microservices (p. 6). CRC Press. Kindle Edition.



멀티클라우드는 뉴노멀

❖ 멀티클라우드는 기업의 뉴노멀 (ONF: Enterprise Multi-Cloud is the New Normal)

- Can't afford to be tied to just a single hyperscaler – 하나의 'Virtual Cloud' 필요

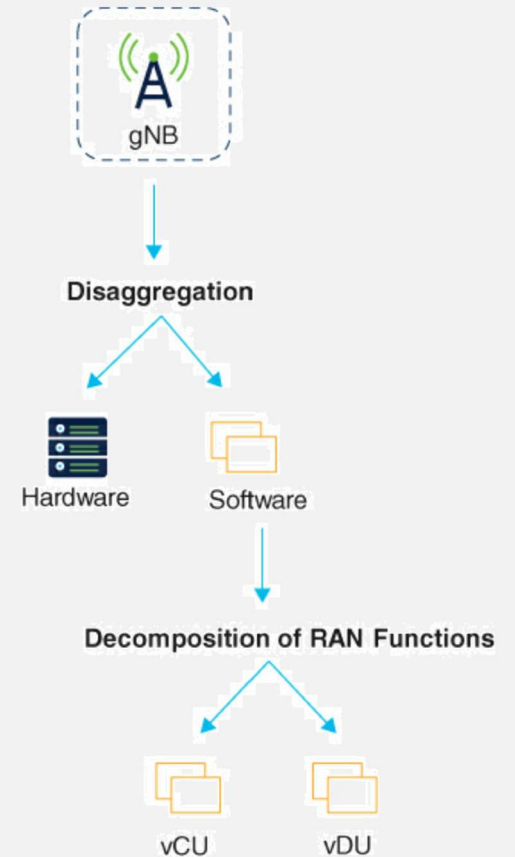
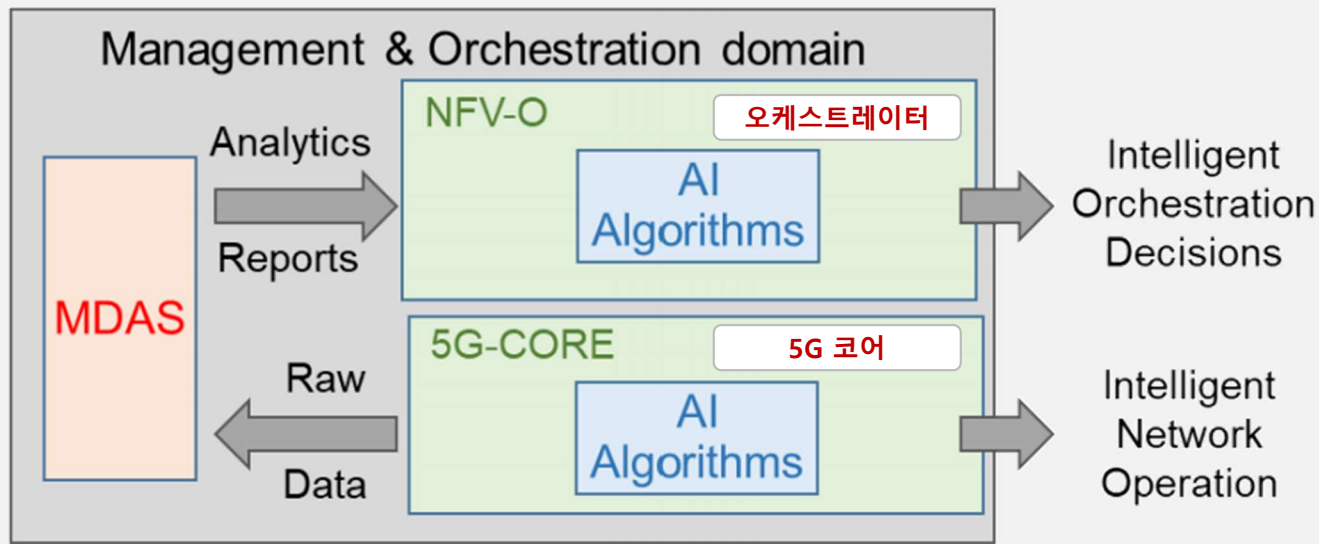


5G 네트워크 가상화 관리의 AI 적용

❖ 가상화 관리의 AI 적용: Management analytics function

- Management Data Analytics Service (MDAS)

The MDAS main functions

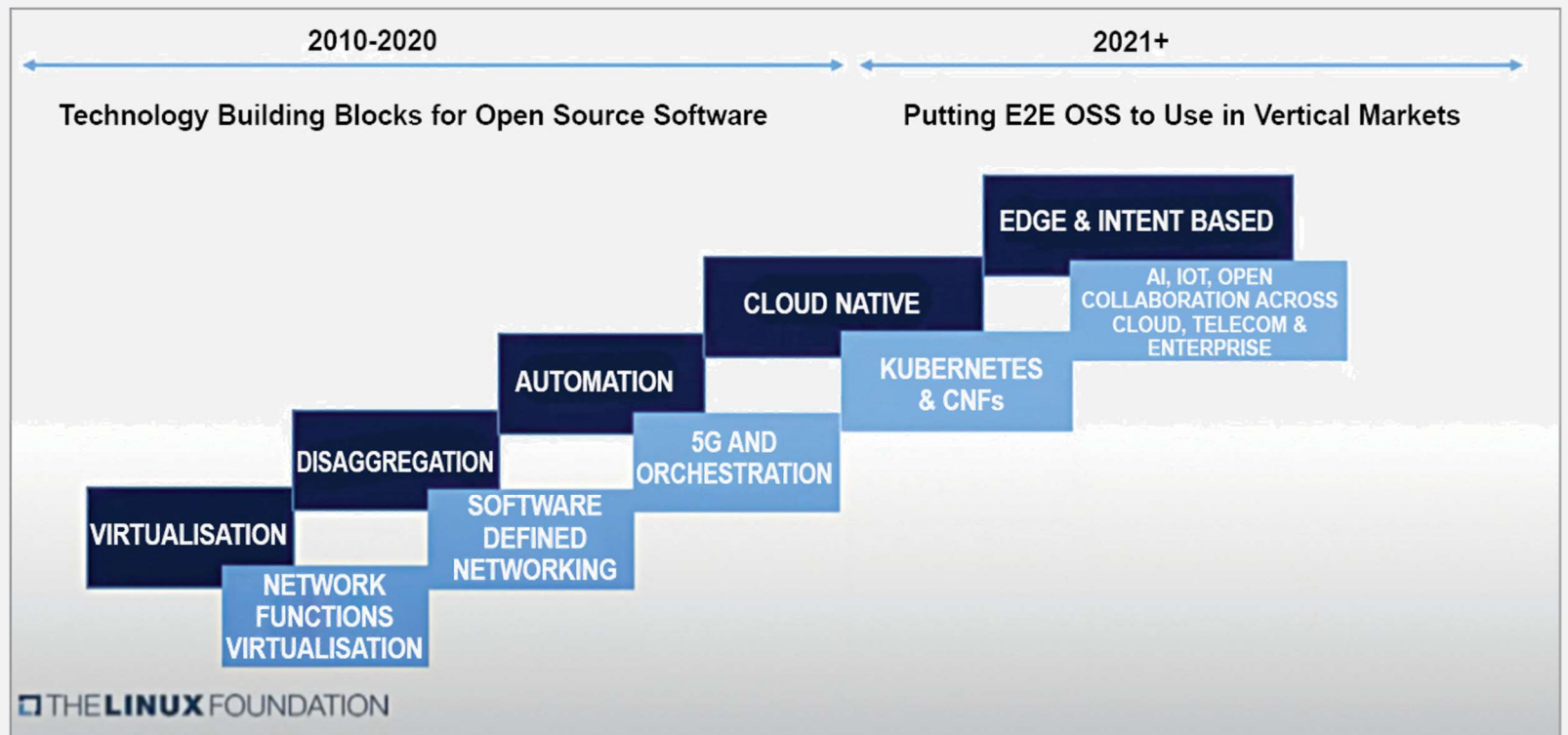


Source: AI and ML – Enablers for Beyond 5G Networks' (URL <http://doi.org/10.5281/zenodo.4299895>) , 5G PPP Technology Board, 2021-05-11



5G/TELECOM NETWORKS 오픈소스 생태계

❖ Focus shifting from building blocks to putting **E2E OSS** to use (리눅스재단)



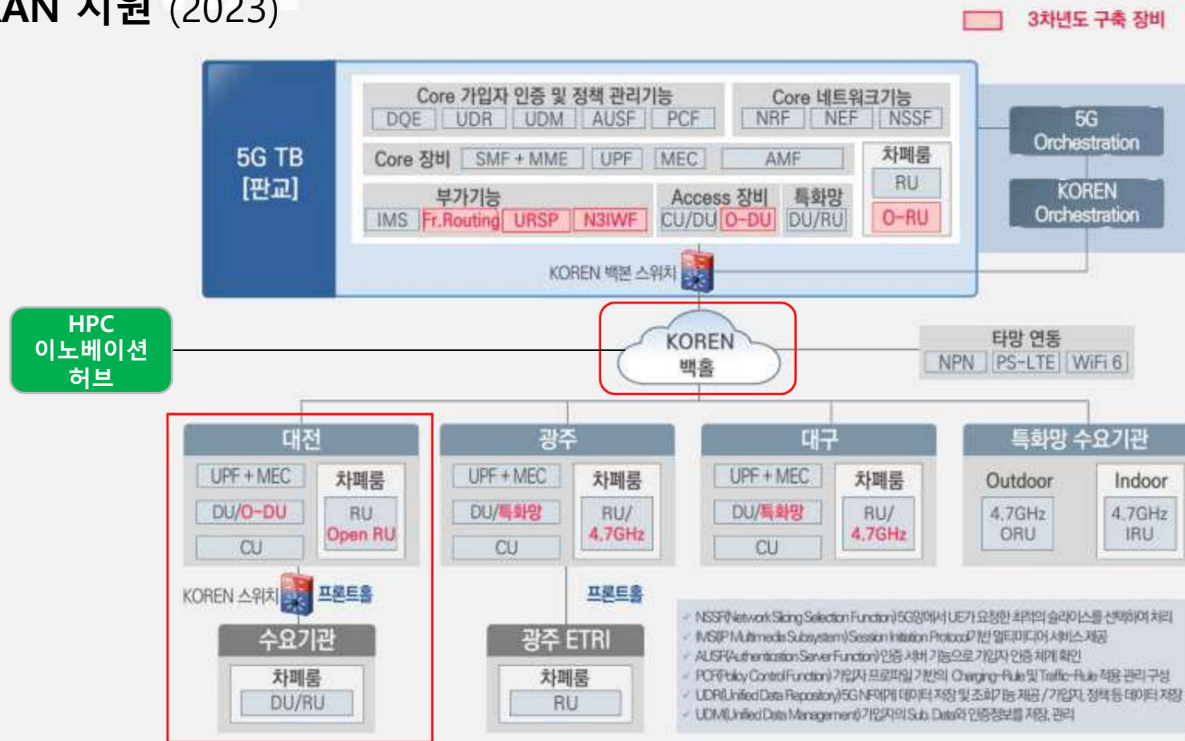
Source: <https://www.electronicsforu.com/technology-trends/open-source-ecosystem-5g-telecom-networks>



5G 융합서비스 테스트베드 (1 OF 2)

❖ 5G 융합서비스 테스트베드 (@KOREN)

- O-RAN 지원 (2023)



5G 테스트베드 목표 구성

- 1차년도** UPF, SMF, AMF 등 5G Core 주요 인프라 구축
- 2차년도** NSA→SA Migration, NSSF, IMS 등 신규 구축 및 Upgrade
- 3차년도** O-RAN, N3IWF, URSP, MEC관제 등 다양한 5G 시험환경 및 통합 운용관리체계 조성

Source: https://ettrends.etri.re.kr/ettrends/197/0905197007/060-069_%EC%98%88%EC%B6%A9%EC%9D%BC_197%ED%98%B8.pdf



5G 융합서비스 테스트베드 (2 OF 2)

❖ 5G 융합서비스 테스트베드 (@KOREN)

5G 오픈테스트랩 시험·검증 환경 구성



ETRI
한국전자통신연구원

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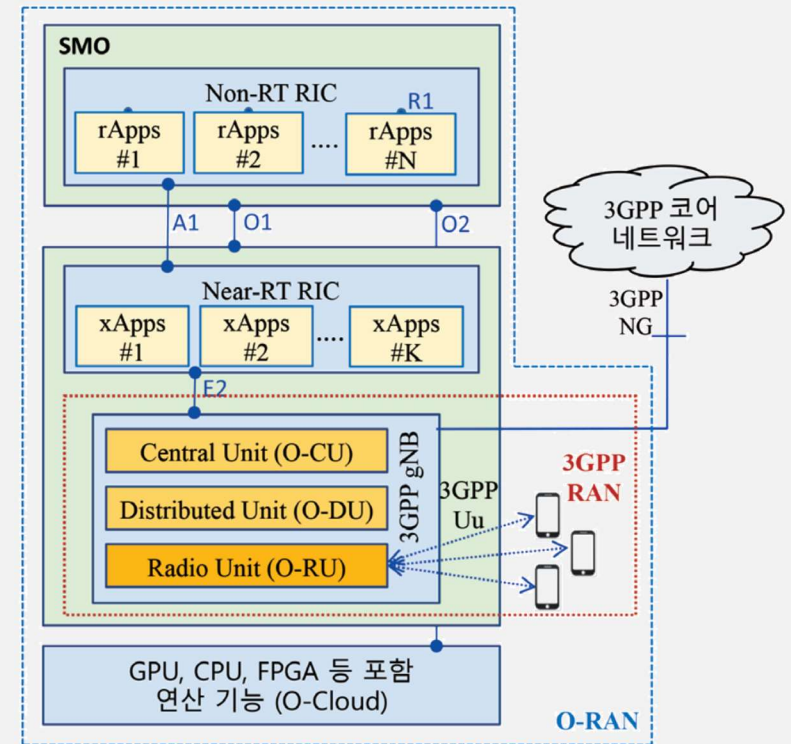
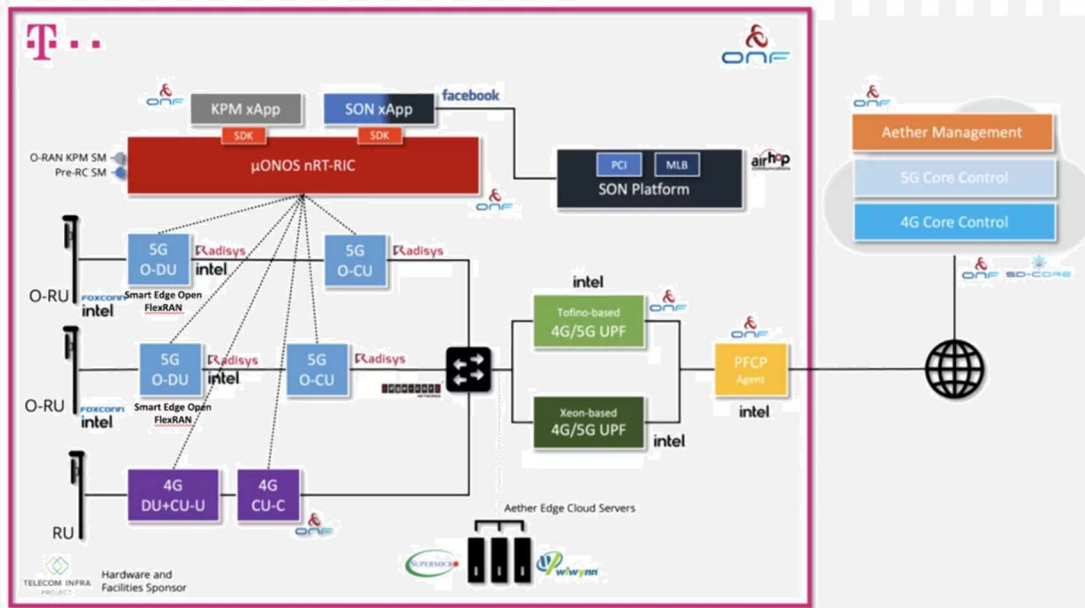
ICT 시험연구센터



O-RAN

❖ O-RAN

- 3GPP RAN과 O-RAN의 비교
- ONF SD-RAN v1.2 (사용 오픈소스: O-RAN, μ ONOS)



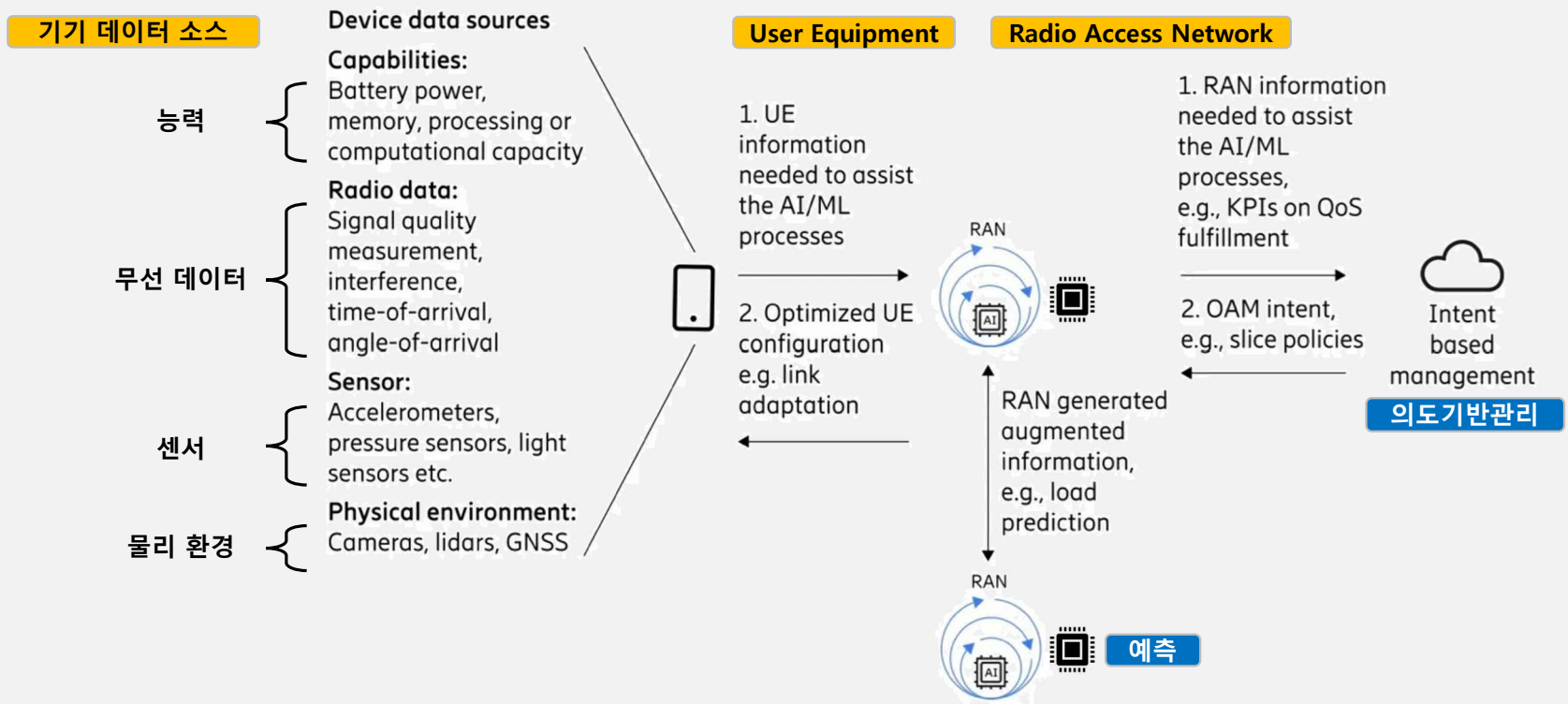
Source: <https://opennetworking.org/news-and-events/blog/onf-facebook-and-radisys-make-strides-participating-in-o-ran-alliance-global-plugfest/>

Source: https://ettrends.etri.re.kr/ettrends/197/0905197007/060-069_%EC%98%88%EC%B6%A9%EC%9D%BC_197%ED%98%B8.pdf



5G RAN CRITICAL ENABLER BY AI

❖ How AI is used in the 5G Radio Access Network (RAN) Critical Enabler

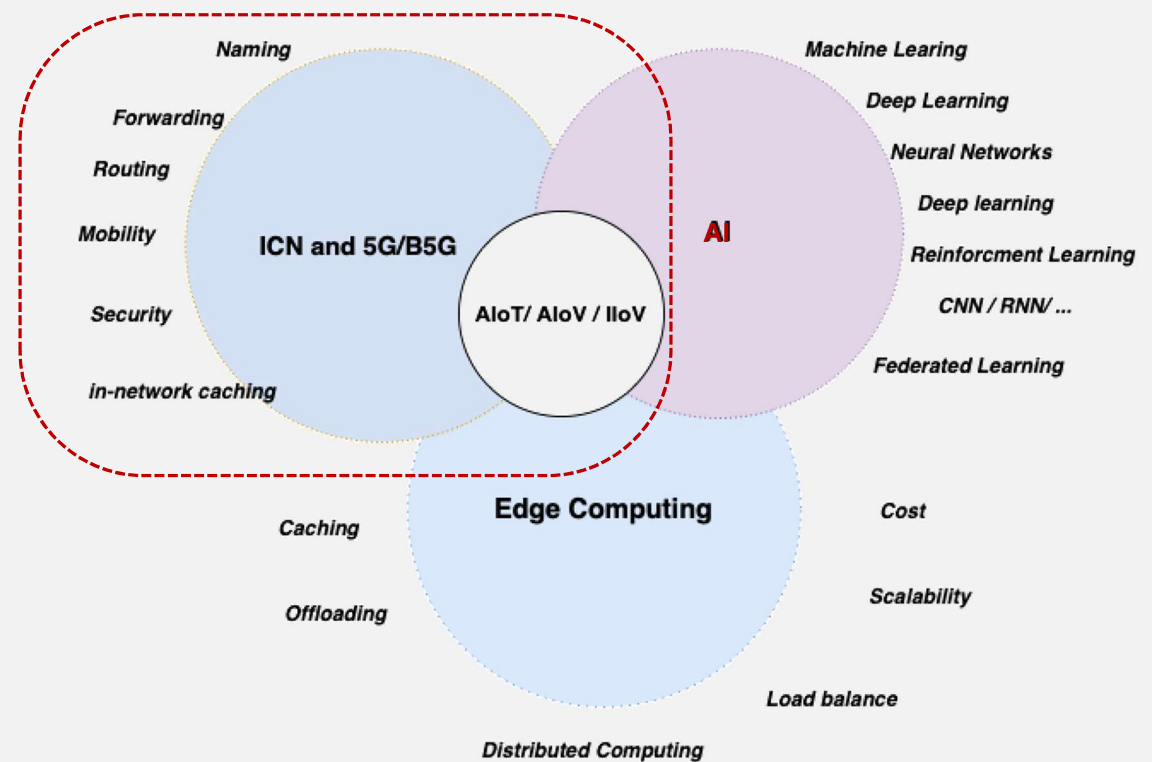


Source: <https://www.rcrwireless.com/20221117/5g/what-ai-ml-ran-enhancements-are-included-in-5g-rel-18> (Image via Ericsson)



ICN-EDGE COMPUTING-AI

❖ The convergence of ICN-Edge Computing-AI for IloV..



IloV (Intelligent Internet of Vehicles)

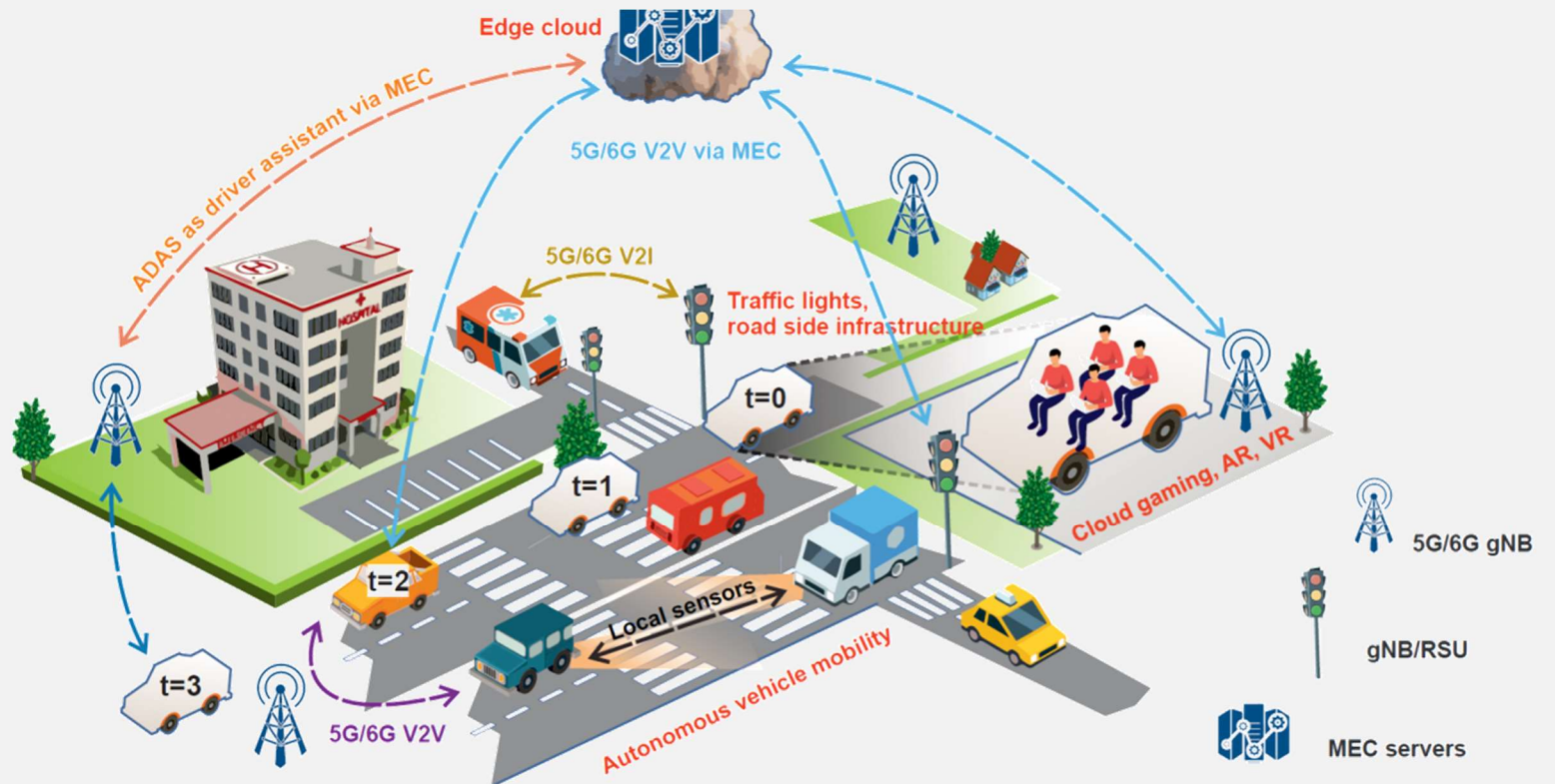
AIoT (Artificial Intelligence of Things)

Source: <https://www.mdpi.com/1999-5903/14/7/192/htm#B20-futureinternet-14-00192>



에지 컴퓨팅 자원의 예측 배당

❖ Predictive allocation of edge computing resources for autonomous driving

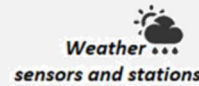


Source: https://6gmobile.fel.cvut.cz/portfolio_category/ml-ai/



모바일을 위한 서비스 예 (1 OF 3)

❖ 모바일을 위한 서비스 (예): A composite service to satisfy a complex task



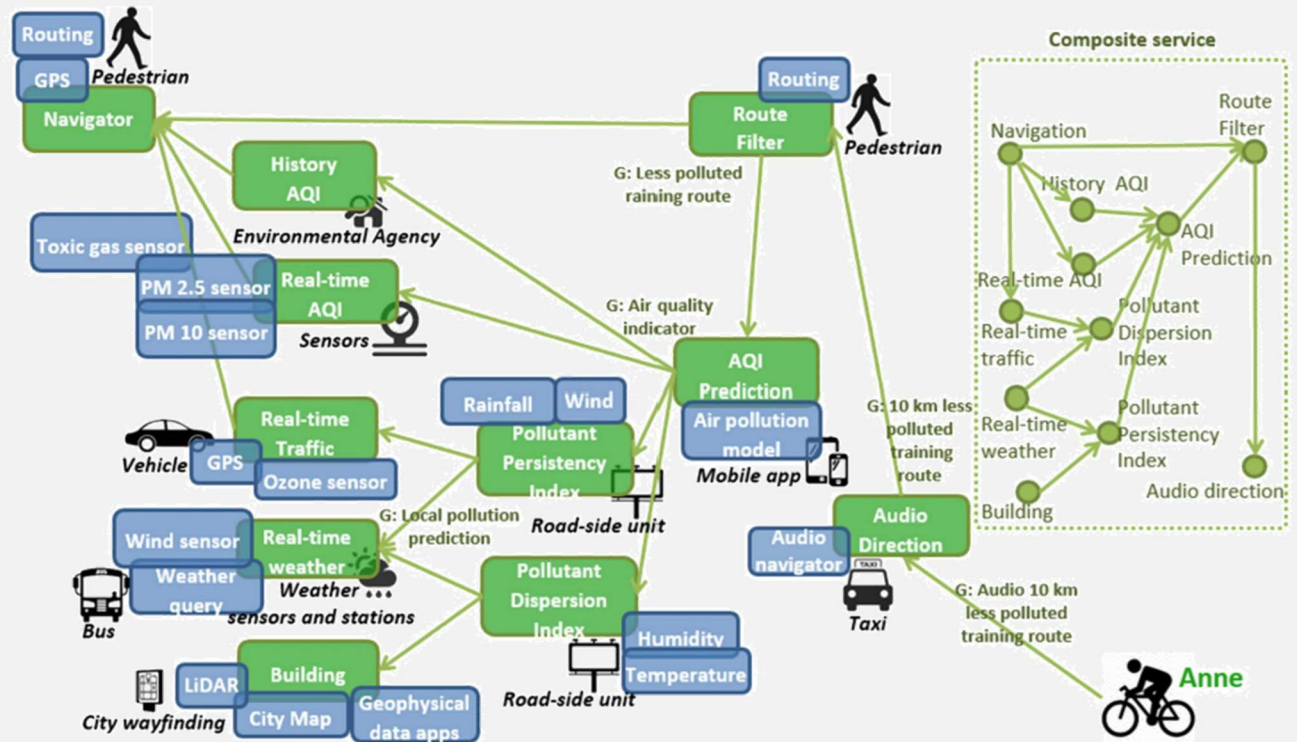
Anne은 10Km 트레이닝 사이클을 위해 공기오염이 적은 경로를 원하며, 스마트워치를 가지고 있다.

Source: Chen, Nanxi. Mobile Microservices (p. 7). CRC Press. Kindle Edition.



모바일을 위한 서비스 예 (2 OF 3)

❖ 모바일을 위한 서비스 (예): A composite service to satisfy a complex task



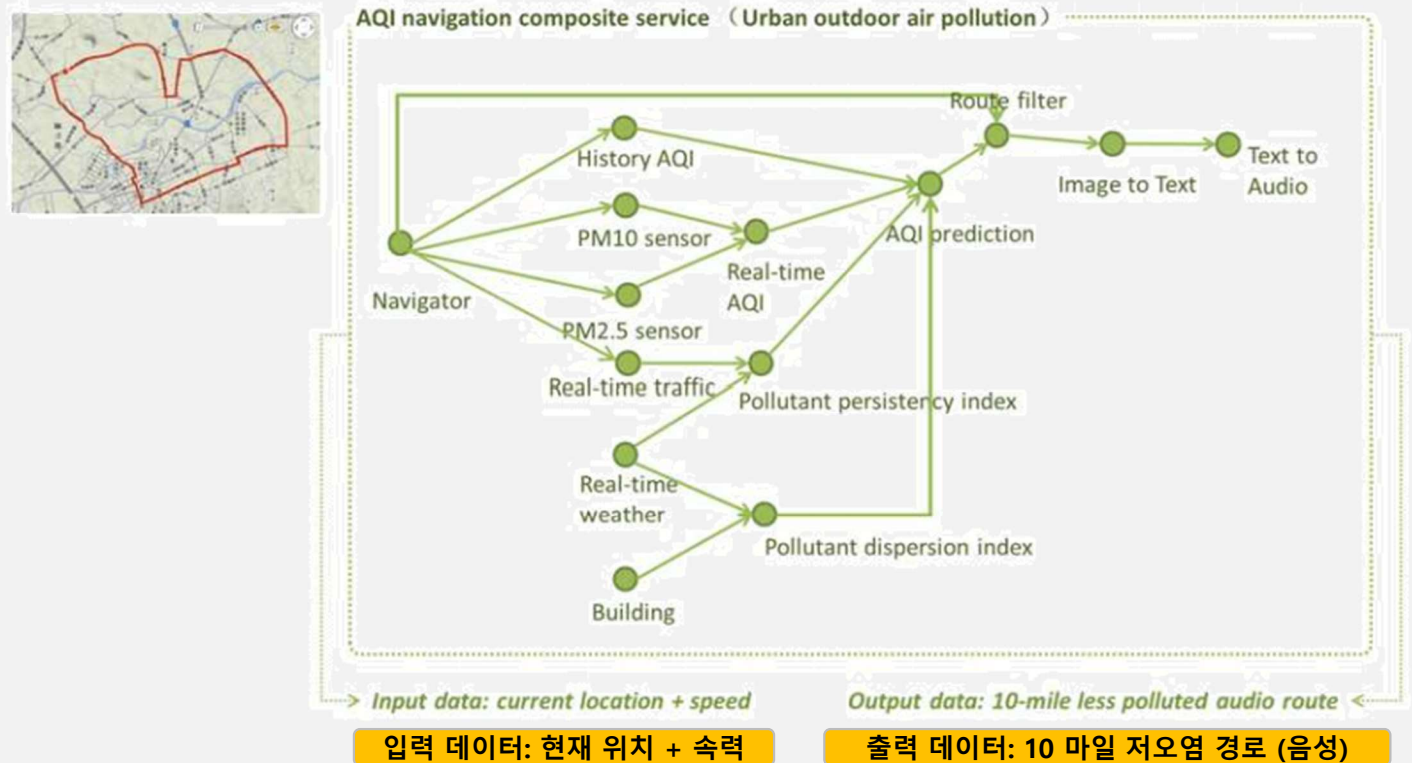
[Air Quality Index \(AQI\)](#)

Source: Chen, Nanxi. Mobile Microservices (p. 7). CRC Press. Kindle Edition.



모바일을 위한 서비스 예 (3 OF 3)

❖ 모바일을 위한 마이크로서비스 (예): Input and output data of the composite service



Source: Chen, Nanxi. Mobile Microservices (p. 8). CRC Press. Kindle Edition.



글로벌 SW기업의 오픈소스 활용 현황

❖ 글로벌 SW기업의 오픈소스 활용 현황

구분	MS	IBM	구글	페이스북	아마존	재단
AI	PROJEPRO Oxford, MS CNTK, ONNX Runtime	SystemML, Watson	DeepMind, TensorFlow	PyTorch, OCP	Neo-AI	OpenAI, Partnership on AI
블록체인	Azure (EBaaS), Confidential Consortium Framework	Bluemix BaaS		Diem		리눅스재단 Hyper Ledger
IoT	Azure IoT Edge	Bluemix (IoT part)	Brillo	Parse	FreeRTOS	AllSeen, oneM2M, 리눅스재단(IoTIVITY)
빅데이터	Azure HDInsight for Hadoop, Spark, Kafka		Mapreduce		Open Distro for Elasticsearch	아파치재단(Hadoop등)
클라우드	Azure Functions Host, Linux-vm-tools, .NET Core	OpenWhisk	PaaS	Cassandra		OpenStack, CloudStack



주요 인공지능 개발용 오픈소스 툴킷

❖ 주요 인공지능 개발용 오픈소스 툴킷

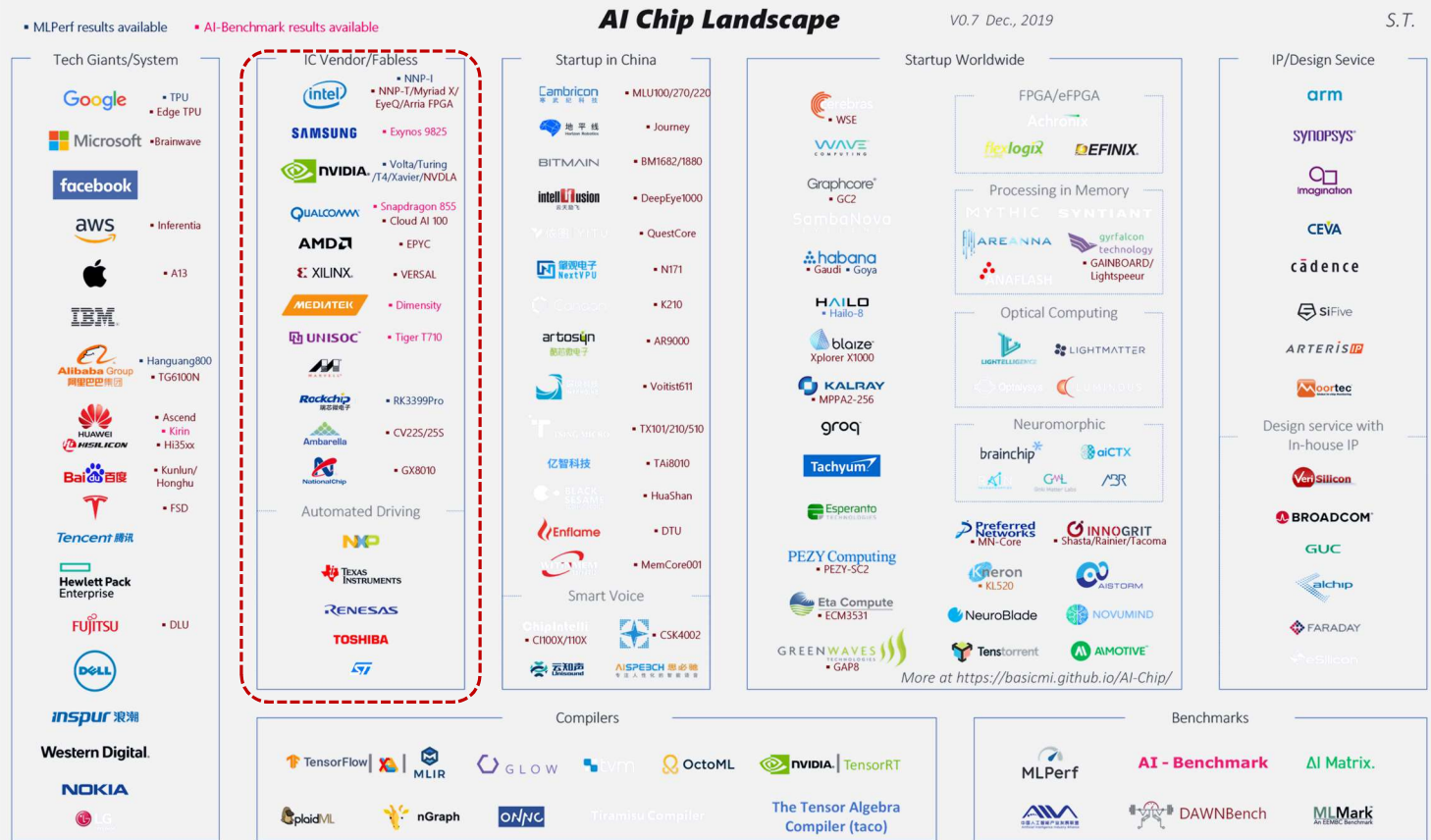
소프트웨어	라이선스	오픈소스	구동환경	언어	인터페이스
Caffe (Berkely Univ)	BSD license	Yes	Linux, macOS, Windows	C++	Python, MATLAB, C++
PyTorch (Facebook, etc)	BSD license	Yes	Linux, macOS, Windows	Python, C, CUDA	Python
TensorFlow (Google)	Apache 2.0	Yes	Linux, macOS, Windows, Android	C++, Python, CUDA	Python(Keras), C/C++, Java, Go, R, Julia
Keras (François Chollet)	MIT license	Yes	Linux, macOS, Windows	Python	Python, R
Theano (Montreal Univ)	BSD license	Yes	Cross-platform	Python	Python (Keras)
Torch (Ronan Collobert et al.)	BSD license	Yes	Linux, macOS, Windows, Android, iOS	C, Lua	Lua, C, utility library for C++/OpenCL
CNTK (MS)	MIT license	Yes	Windows, Linux	C++	Python (Keras), C++
ONNX Runtime (MS)	MIT license	Yes	Cloud & IoT with supported accelerators	C++, Python, C# 등	ONNX



AI CHIP LANDSCAPE

❖ AI Chip Landscape

- Tech Giants/System
- IC Vendor/Fabless
- Startup
- IP/Design Service
- Compilers
- Benchmarks



Source: <https://github.com/basicmi/AI-Chip>

All information contained within this infographic is gathered from the internet and periodically updated, no guarantee is given that the information provided is correct, complete, and up-to-date.





**THANK
YOU**